N89. Latest Results From Elevated Lithium Demo At Millstone-3

Millstone-3 completed its third cycle of operation earlier this year, and results from the fuel examination are now available. Cycle 1 was a 12-month cycle with coordinated chemistry (pH 6.9 and maximum lithium of 2.2 ppm). Cycles 2 and 3 were extended cycles, with maximum lithium of 3.5 ppm. The maximum pH was 7.4 in Cycle 2, and 7.2 in Cycle 3.

The equivalent North Anna data is shown from EPRI LWR Fuels group project to measure oxide thickness at high burn-up. Millstone-3 and North Anna have similar fuel duty, but North Anna used standard pH 6.9 coordinated chemistry. The lithium was about 3 ppm at the start of the extended cycles at North Anna, but the total time above 2.2 ppm lithium was much less than at Millstone. The preliminary evaluation of the Millstone data by Westinghouse indicated that, although oxide thicknesses were greater than expected, the high variability in measured thickness at similar burn-ups precludes concluding there is a significant lithium-enhancement of zircaloy oxidation rate. EPRI is arranging for a separate evaluation of both sets of data by Nuclear Electric, using predictive models developed from the Nuclear Fuels Industry Research program.

The steam generator radiation fields at Millstone are approximately 50% of the average for modern Westinghouse units with Inconel fuel grids. Including the Ringhals 3 and 4 plant data, there seems to be no significant difference between pH 7.2 and 7.4, and both seem to be significantly superior to pH 6.9. Based on actual plant exposures and computer code projections of fields, if the pH 6.9 regime used in Cycle 1 had been continued for Cycle 2 (actual pH 7.4) and Cycle 3 (pH 7.2), exposure savings of 26 man rem (232 projected, 206 actual) in Cycle 2 and 40 man rem (220 projected, 180 actual) in Cycle 3 were estimated by Westinghouse. Even if the plant reverts to pH 6.9 for the next two cycles, projected man-rem savings exceed 50 man rem per cycle.

There have been no major changes recently concerning lithium enhancement of primary water stress corrosion cracking of Inconel steam generator tubing. Laboratory tests in Japan seem to confirm the earlier Westinghouse tests (recently published in detail in EPRI Report NP-7396) that greater than 2.2 ppm lithium shortened the initiation time in slow-strain and reverse U-bend test. Interestingly, 2.2 ppm lithium was also superior to low lithium concentrations; this is consistent with the tentative finding in the Westinghouse work that 2.2 ppm/300 ppm B (pH 7.4) was superior to 0.67 ppm/300 ppm B (pH 6.9).

Summarizing all of the above, the new data does not seem to indicate an immediate need to change the set of principles in the primary chemistry guidelines.

Taken From: "Latest Results from Elevated Lithium Demo at Millstone-3," Christopher Wood, Radiation Control News, No. 11, September 1991. For further information, call Chris Wood at EPRI, (415) 855-2379.